Content:

- Test all OTN rates up to 11.095 Gbps with one single module
- Accurate FEC performance evaluation with O.182
- Field exchangeable XFP and SFP transceivers
- Fast and professional reports

Test all OTN rates up to 11.095 Gbps with one single module

The emergence of ITU-T G.709 recommendation in 2001 (“Network Node Interfaces for the Optical Transport Network (OTN”) has paved the way for a new generation of DWDM optical transport networks whereby several important mechanisms enable the following capabilities:

- Management and intelligence in the optical domain
- Compatibility with all existing network communication protocols
- Enhancement of about 5-6 dB in optical budget through the use of Forward Error Correction scheme (FEC)

The CMA5000-UTA module supports the OTU-1 (2.66 Gbps) and OTU-2 (10.709 Gbps) frame formats as defined in the G.709 recommendation. In addition, the UTA module also supports the 11.049 Gig FEC and 11.095 Gig FEC formats. Both formats are identical to standard OTU-2 frame but with overclocking in order to authorize the mapping of 10GigE-LAN traffic directly into the OTN frame. The 2 rates (11.049 and 11.095 Gbps) correspond to the 2 different methods of mapping into OTU-2: with and without fixed stuff (see figure 1).
Key Features

- Multi-rates OTN support:
  - OTU-2 (10.709 Gbps)
  - OTU-1 (2.66 Gbps)
  - 11.049 Gbps FEC
  - 11.095 Gbps FEC
- SDH/SONET mapping into OTU-1/OTU-2 frames
- ODU-1 mapping into OTU-2
- Edition of OTN overhead bytes: OTU, ODU, OPU
- FEC encoder / decoder can be activated / deactivated
- Poisson error generation according to ITU-T O.182 recommendation
- Field exchangeable XFP
- Automatic test report in PDF

Key Applications

- Installation, commissioning and troubleshooting tests
- Accurate FEC performance evaluation through O.182 error insertions
- Test of “extended OTN” equipments at 11.049 Gbps and 11.095 Gbps

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**Fig.1:** The different OTN frames supported by the CMA5000-UTA
Accurate FEC performance evaluation with O.182

The ITU-T G.709 Optical Transport Network (OTN) Forward Error Correction (FEC) code uses the Reed Solomon codes (RS255 and RS239). Since the Reed Solomon codes are block codes, generation of pseudo-random errors makes it impossible to evaluate FEC decoder performance properly by comparing the error correction performance with the theoretical curve. Accordingly, a new method of error generation has been specified by the ITU-T O.182 recommendation. This method involves a special Poisson error generator that approximates the actual conditions of an in-service network and is a suitable condition for evaluating FEC performance. The CMA5000-UTA has a Poisson error generator fully compliant to O.182.

Field exchangeable XFP and SFP transceivers

The UTA module supports hot pluggable XFP and SFP transceivers. This feature brings a lot of configurability to the module. In the field, the user just has to replace the XFP/SFP by another to change the optical interface characteristics. This is particularly important as many optical interface standards exist today, each of them specifying a wavelength and a maximum transmission range.

![Fig. 3: Change the optical interface of your module in the field via XFP/SFP transceivers](image)
Fast and professional reports
Creating professional reports has never been so easy with the UTA application. After stopping a measurement, the report is just one click away: produce, save, print reports directly from the application. Select the set of results you want to produce, fill in the header information associated with the measurement and the UTA application will generate professionally presented reports in PDF format.

Fig. 4: Generate automatic test report in PDF format with just one click
## Interfaces and Signal Specifications

<table>
<thead>
<tr>
<th>Signal</th>
<th>Port/Connector</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU-2 (10.709 Gb/s)</td>
<td>One XFP port</td>
<td>As per G.709</td>
</tr>
<tr>
<td>11.049 Gb/s FEC</td>
<td></td>
<td>As per GSup43 subclause 7.2</td>
</tr>
<tr>
<td>11.095 Gb/s FEC</td>
<td></td>
<td>As per GSup43 subclause 7.1</td>
</tr>
<tr>
<td>OTU-1 (2.66 Gb/s)</td>
<td>One SFP port</td>
<td>As per G.709</td>
</tr>
</tbody>
</table>

### Optical Interfaces

#### XFP

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Ref.</th>
<th>Wavelength</th>
<th>Output Power</th>
<th>Reach</th>
<th>Overload</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU-2 / 11G FEC</td>
<td>5610-150-UTA</td>
<td>1310 nm</td>
<td>-6 to -1 dBm</td>
<td>10 km</td>
<td>-1 dBm</td>
<td>-11 dBm</td>
</tr>
<tr>
<td></td>
<td>5610-142-UTA</td>
<td>1550 nm</td>
<td>-1 to +2 dBm</td>
<td>40 km</td>
<td>-1 dBm</td>
<td>-14 dBm</td>
</tr>
<tr>
<td></td>
<td>5610-143-UTA</td>
<td>1550 nm</td>
<td>0 to +4 dBm</td>
<td>80 km</td>
<td>-7 dBm</td>
<td>-24 dBm</td>
</tr>
</tbody>
</table>

#### SFP

<table>
<thead>
<tr>
<th>Interfaces</th>
<th>Ref.</th>
<th>Wavelength</th>
<th>Output Power</th>
<th>Reach</th>
<th>Overload</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU-1</td>
<td>5610-144-UTA</td>
<td>1310 nm</td>
<td>-2 to +3 dBm</td>
<td>40 km</td>
<td>-9 dBm</td>
<td>-25 dBm</td>
</tr>
<tr>
<td></td>
<td>5610-145-UTA</td>
<td>1550 nm</td>
<td>-2 to +3 dBm</td>
<td>80 km</td>
<td>-9 dBm</td>
<td>-26 dBm</td>
</tr>
</tbody>
</table>

#### Clock Synchronization

- **Clock Reference**
  - Internal stratum 3 clock generation
  - External 2.048 MHz reference clock
  - Timed from 2.048 Mbit/s received signal
  - External 1.544 MHz reference clock
  - Timed from 1.544 Mbit/s received signal
  - External 5 MHz clock
  - External 10 MHz clock
  - Timed from OTU-2/OTU-1/11.049 Gbps/11.095 Gbps received signal

- **Clock Output**
  - Line rate divided by 16
  - 10 MHz

## Notes

1. The XFP and SFP interfaces of the UTA module meet the requirements stated in the MSA standard
2. XFP and SFP must be ordered separately
### Frame Formats

<table>
<thead>
<tr>
<th>Format</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTN format</td>
<td>OTU-2 and OTU-1 as per ITU-T G.709</td>
</tr>
<tr>
<td>SDH format</td>
<td>STM-64 and STM-16 as per ITU-T G.707</td>
</tr>
<tr>
<td>SONET format</td>
<td>OC-192 and OC-48 as per Telcordia GR-253</td>
</tr>
</tbody>
</table>

### Unframed Signals

<table>
<thead>
<tr>
<th>Rates</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10.709 Gbps</td>
<td></td>
</tr>
<tr>
<td>11.096 Gbps</td>
<td></td>
</tr>
<tr>
<td>11.096 Gbps</td>
<td></td>
</tr>
<tr>
<td>10.709 Gbps</td>
<td></td>
</tr>
</tbody>
</table>

### OTU-2 Mappings & Structures

- **10.709 Gbps**
  - OTU-2 → ODU-2 → OPU-2 → CBR 10G async.
  - Internal STM-64/OC-192
  - Test
  - (*) FEC encoder can be activated/deactivated
  - ODU-1
  - CBR 10G sync.
  - Internal STM-64/OC-192
  - Test
  - (*) FEC decoder can be activated/deactivated
  - BULK
  - Test

- **11.096 Gbps**
  - OTU-2 → ODU-2 → OPU-2 → CBR 10G async.
  - Test
  - CBR 10G sync.
  - Test

- **11.049 Gbps**
  - Unframed
  - Test

- **10.709 Gbps**
  - PRBS
OTU-1 Mappings & Structures

2.66 Gbps

OTU-1 → ODU-1 → OPU-1 → CBR 2.5G async.

CBR 2.5G sync.

(*) FEC encoder can be activated/deactivated
(⁎) FEC decoder can be activated/deactivated

Unframed → BULK → PRBS

Test Patterns

PRBS
- PRBS 31, PRBS 23, PRBS 15 (inverted and non-inverted)

Patterns
- NULL pattern, All "1s", All "0s", Alternate "01", 16 bit user programmable pattern

Internal SDH Frame Structures

OPU-2 → STM-64 → AU-4-64c → VC-4-64c → C-4-64c

Bulk

OPU-1 → STM-16 → AU-4-16c → VC-4-16c → C-4-16c

Bulk

AU-4-4c → VC-4-4c → C-4-4c

Bulk

AU-4 → VC-4 → C-4

Bulk
Internal SONET Frame Structures

<table>
<thead>
<tr>
<th>OPU-2</th>
<th>OC-192</th>
<th>STS-192</th>
<th>STS-192c</th>
<th>STS-192c SPE</th>
<th>Bulk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPU-1</td>
<td>OC-48</td>
<td>STS-48</td>
<td>STS-48c</td>
<td>STS-48c SPE</td>
<td>Bulk</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>STS-12</td>
<td>STS-12c</td>
<td>STS-12c SPE</td>
<td>Bulk</td>
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<tr>
<td></td>
<td></td>
<td>STS-3</td>
<td>STS-3c</td>
<td>STS-3c SPE</td>
<td>Bulk</td>
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<tr>
<td></td>
<td></td>
<td>STS-1</td>
<td>STS1 SPE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OTN Overhead Editors

<table>
<thead>
<tr>
<th>Editor</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU Editor</td>
<td>FAS: OA1, OA2</td>
</tr>
<tr>
<td></td>
<td>SM: SAPI, DAPI, Operator bytes</td>
</tr>
<tr>
<td></td>
<td>GCC 0</td>
</tr>
<tr>
<td>ODU Editor</td>
<td>RES: 3 bytes</td>
</tr>
<tr>
<td></td>
<td>TCM/ACT: 1 byte</td>
</tr>
<tr>
<td></td>
<td>TCM-i (i=1 to 6): SAPI, DAPI, Operator bytes</td>
</tr>
<tr>
<td></td>
<td>FTFL: 1 byte</td>
</tr>
<tr>
<td></td>
<td>GCC 1: 2 bytes</td>
</tr>
<tr>
<td></td>
<td>GCC 2: 2 bytes</td>
</tr>
<tr>
<td></td>
<td>APS/PCC: 4 bytes</td>
</tr>
<tr>
<td>OPU Editor</td>
<td>PSI: PT</td>
</tr>
</tbody>
</table>

SDH/SONET Overhead Editors

<table>
<thead>
<tr>
<th>Frame</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH</td>
<td>All bytes of SOH (STM-1) are programmable except B1/B2</td>
</tr>
<tr>
<td></td>
<td>J0 (Trace Identifier): programmable 15 bytes ASCII sequence, CRC (E.164) added</td>
</tr>
<tr>
<td>POH</td>
<td>C2, G1, F2, H4, F3, K3, N1</td>
</tr>
<tr>
<td></td>
<td>J1 (trace Identifier): programmable 15 bytes ASCII sequence, CRC (E.164) added</td>
</tr>
<tr>
<td>SONET Frame</td>
<td>All bytes of SOH (STS-3) are programmable except B1/B2 and Z0</td>
</tr>
<tr>
<td></td>
<td>J0 (Trace Identifier): programmable 62 bytes ASCII sequence, CRLF added</td>
</tr>
<tr>
<td>POH</td>
<td>C2, G1, F2, H4, Z3, Z4, N1</td>
</tr>
<tr>
<td></td>
<td>J1 (trace Identifier): programmable 62 bytes ASCII sequence, CRLF added</td>
</tr>
</tbody>
</table>
Errors Addition

<table>
<thead>
<tr>
<th>Component</th>
<th>Error Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH over OTN</td>
<td>• A1/A2, B1, B2, B3, MS-REI, AU-REI, ERR</td>
</tr>
<tr>
<td>SONET over OTN</td>
<td>• A1/A2, B1, B2, B3, REI-L, REI-P, ERR</td>
</tr>
<tr>
<td>OTN</td>
<td>• <strong>FEC:</strong>&lt;br&gt;Correctable FEC bit, Correctable FEC block, Uncorrectable FEC block&lt;br&gt;Error generation according to O.182 (Poisson error generation)&lt;br&gt;• <strong>OTU:</strong>&lt;br&gt;FAS, MFAS, SM-BIP 8, SM-BEI&lt;br&gt;• <strong>ODU:</strong>&lt;br&gt;PM-BIP 8, PM-BEI</td>
</tr>
</tbody>
</table>

Error Control
• Programmable number or Rate<br>• FEC error control: User-programmable 8-bit mask

Alarms Addition

<table>
<thead>
<tr>
<th>Component</th>
<th>Alarm Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDH over OTN</td>
<td>• LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-PLM, HP-TIM, HP-UNEQ, HP-RDI, LSS</td>
</tr>
<tr>
<td>OTN</td>
<td>• <strong>OTU:</strong>&lt;br&gt;LOF, OOF, LOM, OOM, OTU-AIS, SM-TIM, SM-IAE, SM-BDI, SM-BIAE, SM-SAPI, SM-DAPI&lt;br&gt;• <strong>ODU:</strong>&lt;br&gt;ODU-AIS, ODU-LCK, ODU-OCI, PM-BDI, PM-SAPI, PM-DAPI&lt;br&gt;• <strong>OPU:</strong>&lt;br&gt;PLM</td>
</tr>
</tbody>
</table>

Alarm Control<br>• On steady-state or programmable number of frames

Test Functions

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTU Frequency Shift</td>
<td>• Programmable frequency offset: -100 ppm to +100 ppm</td>
</tr>
<tr>
<td>OPU Justifications</td>
<td>• Generation of payload frequency offset: -65 ppm to +65 ppm</td>
</tr>
<tr>
<td>FEC</td>
<td>• FEC encoder can be deactivated</td>
</tr>
<tr>
<td>SDH/SONET Pointer Movements</td>
<td>• Pointer movement generation:&lt;br&gt;o Pointer set to any value with or without NDF&lt;br&gt;o Positive and Negative movements&lt;br&gt;o G.783 sequences</td>
</tr>
</tbody>
</table>
### OTN Analysis

| Signal Qualification | • Power meter (dB)  
<table>
<thead>
<tr>
<th></th>
<th>• Frequency meter (ppm)</th>
</tr>
</thead>
</table>
| Error Analysis        | • **FEC:**  
|                      | FEC bit, FEC block, FUEB  
|                      | • **OTU:**  
|                      | FAS, MFAS, SM-BIP 8, SM-BEI  
|                      | • **ODU:**  
|                      | PM-BIP 8, PM-BEI  
|                      | • **Payload:**  
|                      | ERR  |
| Alarm Analysis        | • **OTU:**  
|                      | LOF, OOF, LOM, OOM, OTU-AIS, SM-TIM, SM-IAE, SM-BDI, SM-BIAE  
|                      | • **ODU:**  
|                      | ODU-AIS, ODU-LCK, ODU-OCI, PM-BDI, PM-TIM  
|                      | • **OPU:**  
|                      | PLM  |
| Justifications        | • Positive and Negative OPU justifications count  
|                      | • OPU frequency shift (ppm) |

### SDH/SONET over OTN Analysis

#### SDH

<table>
<thead>
<tr>
<th>Error Analysis</th>
<th>• A1/A2, B1, B2, B3, MS-REI, AU-REI, ERR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm Analysis</td>
<td>• LOF, OOF, RS-TIM, MS-AIS, MS-RDI, AU-AIS, AU-LOP, HP-PLM, HP-TIM, HP-UNEQ, HP-RDI, LSS</td>
</tr>
</tbody>
</table>
| Pointer Movements| • Pointer value  
|                      | • Number of positive and negative pointer movements  
|                      | • Number of pointer movements with NDF |

#### SONET

<table>
<thead>
<tr>
<th>Error Analysis</th>
<th>• A1/A2, B1, B2, B3, REI-L, REI-P, ERR</th>
</tr>
</thead>
</table>
| Pointer Movements| • Pointer value  
|                      | • Number of positive and negative pointer movements  
|                      | • Number of pointer movements with NDF |
### Ordering Information

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5610-000-UTA</td>
<td>UTA base module</td>
</tr>
<tr>
<td></td>
<td>*Applications must be ordered separately</td>
</tr>
<tr>
<td>5610-301-UTA</td>
<td>OTN application for UTA module supporting:</td>
</tr>
<tr>
<td></td>
<td>- OTU-2 interface (XFP not included)</td>
</tr>
</tbody>
</table>

#### Options

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5610-311-UTA</td>
<td>OTU-1&quot; option for OTN application (SFP not included)</td>
</tr>
</tbody>
</table>

#### Accessories

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5610-150-UTA</td>
<td>1310 nm XFP transceiver (10 km) (LC connector)</td>
</tr>
<tr>
<td></td>
<td>* Multi-rates XFP supporting STM-64/OC-192/10 GigE/OTU-2</td>
</tr>
<tr>
<td>5610-142-UTA</td>
<td>1550 nm XFP transceiver (40 km) (LC connector)</td>
</tr>
<tr>
<td></td>
<td>* Multi-rates XFP supporting STM-64/OC-192/10 GigE/OTU-2</td>
</tr>
<tr>
<td>5610-143-UTA</td>
<td>1550 nm XFP transceiver (80 km) (LC connector)</td>
</tr>
<tr>
<td></td>
<td>* Multi-rates XFP supporting STM-64/OC-192/10 GigE/OTU-2</td>
</tr>
<tr>
<td>5610-144-UTA</td>
<td>1310 nm SFP transceiver (40 km) (LC connector)</td>
</tr>
<tr>
<td></td>
<td>* Multi-rates SFP supporting STM-1/4/16/OC-3/12/48/OTU-1</td>
</tr>
<tr>
<td>5610-145-UTA</td>
<td>1550 nm SFP transceiver (80 km) (LC connector)</td>
</tr>
<tr>
<td></td>
<td>* Multi-rates SFP supporting STM-1/4/16/OC-3/12/48/OTU-1</td>
</tr>
</tbody>
</table>

#### Upgrades

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5610-360-UTA</td>
<td>UTA upgrade with &quot;OTN application supporting OTU-2 &quot; (XFP not included)</td>
</tr>
<tr>
<td>5610-361-UTA</td>
<td>UTA upgrade with &quot;OTU-1&quot; option (SFP not included)</td>
</tr>
<tr>
<td></td>
<td>* Requires the &quot;OTN&quot; application</td>
</tr>
</tbody>
</table>

**Note 1:** For best performance, the CMA5000 platform must have 512M RAM when using UTA with more than one application.

**Note 2:** All the 10G/11G applications are field upgradeable.

For upgrades with reference 5610-361-UTA, customers must call their Anritsu contact with module Serial Number as hardware upgrade might be required.
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